**No of Pages : 3** **Course Code: 08P003**

Roll No:
(To be filled in by the candidate)

# PSG COLLEGE OF TECHNOLOGY, COIMBATORE - 641 004

## SEMESTER EXAMINATIONS, OCTOBER / NOVEMBER 2012

**BE / BE(SW) - PRODUCTION ENGINEERING** **Semester: 7/9**

## 08P003 INDUSTRIAL ROBOTICS

**Time: 3 Hours** **Maximum Marks: 100**

| **INSTRUCTIONS:** |
|---|
| 1. Group I and Group II questions should be answered in the Main Answer Book. |
| 2. Answer any **FIVE** questions in Group II. |
| 3. Answer **ALL** questions in Group I and Group III. |
| 4. Group III – **Multiple Choice questions** - (which will be given to the candidates half an hour before the scheduled close of the examination) **should be answered only** in the space provided **in the Main Answer Book.** |

**GROUP I** **Marks: 10 x 3 = 30**

1. Determine the mobility of the dump truck mechanism shown in figure 1.
2. Define control resolution.
3. Classify robots based on path control.
4. A 2 DOF RR configuration robot is required to produce a force of F ($F_x$,$F_y$) Newton at the wrist end. Joint actuators are at the base and the motion is transmitted through belt drives. Assume L1, L2 as link lengths and θ1, θ2 as joint rotations. Neglecting all losses, determine the torque required by the first joint at the base.
5. Comment on the position of joint actuators in a robotic manipulator.
6. A vacuum cup gripper is used to lift plates of stainless steel (ρ = 7750 kg / $m^3$). Each piece of steel is 6.35 mm thick and measures 610 X 915 mm. The gripper utilizes two suction cups separated by 460 mm for stability. Each suction cup is round and has a diameter of 125 mm. The negative pressure required to lift the plates is to be determined. A safety factor of 1.6 is to be included to accommodate acceleration effects.
7. Illustrate the measurement of velocity of a rotating shaft using inductive pick up sensor.
8. If $P_{xyz} = (4, 3, 2)^T$ , determine the corresponding points with respect to the n-o-a co-ordinate system after it has been rotated 60° about the Z axis.
9. List the parameters involved in a D-H transformation matrix.
10. Define charge coupling.

No of Pages : 3 Course Code: 08P003

GROUP II Marks: 5 x 12 = 60

11. For the 6 DOF articulated robot shown in figure 2,
    a. assign the coordinate frames as necessary based on the D-H representation
    b. fill the parameter table
    c. write all the A matrices
    d. find ${}^{0}T_{2}$ transformation matrix.
12. Explain the measurement of position using non-contact type of sensors.
13. a) Show that the transformation matrix representing Rot (x, θ) is an unitary matrix. (4)
    b) A point P $(1, 5, 4)^T$ attached to the frame F (n, o, a) is subjected to the following transformations: rotation of 90° about x-axis; translation of 3 units about a-axis; rotation of 90° about z-axis; translation of 5 units about o-axis. Determine the final location of point P relative to the reference frame. (8)
14. a) One of the axis of a RRL robot is a sliding mechanism with a total range of 0.70 m. The control memory has a 10-bit capacity. In addition, it has been observed that the mechanical inaccuracies associated with moving the arm to any given programmed point form a normal distribution with mean at the taught point and standard deviation equal to 0.10 mm. Determine the following:
    i) control resolution for this axis (4)
    ii) spatial resolution for this axis
    iii) accuracy of the robot at this axis
    iv) repeatability
    b) Explain the terms: i) payload ii) response and stability (8)
15. Write short notes on the following types of grippers
    a) vacuum gripper b) magnetic gripper c) adhesive gripper
16. In an aluminum die casting industry, the molten metal is in the crucible. A robot must be employed for fetching the molten metal in a ladle and pour into the mould cavity. The crucible and the mould box are kept at a distance from the robot. Design a manipulator and perform the kinematic analysis to determine the end position of the gripper.

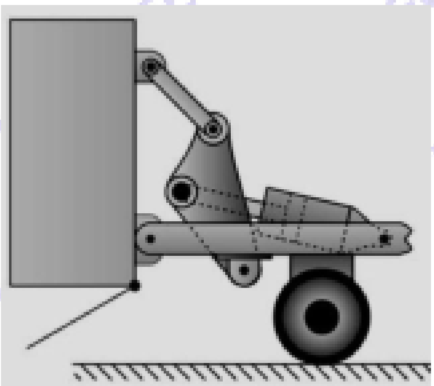


Figure 1

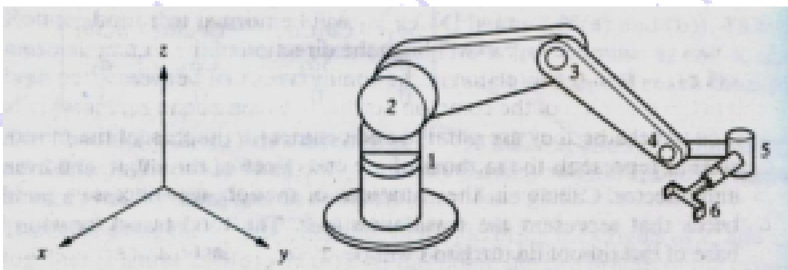



Figure 2

FD/RL /END/

No of Pages : 3 Course Code: 08P003

Roll No:

Write the Alphabet of your choice answer for each question in the space provided in the Main Answer Book
(Do not attach this question paper along with the Main Answer Book)

OCTOBER / NOVEMBER – 2012

08P003 INDUSTRIAL ROBOTICS

GROUP III Marks: 10 x 1 = 10

I) The type of sensor preferred to sense the presence of thin films is
**A)** Inductive proximity **B)** Capacitive proximity **C)** Encoder **D)** Tacho generator

II) Robotic configuration preferred for assembly application is
**A)** Polar **B)** Cartesian **C)** Cylindrical **D)** SCARA

III) Of the different types of automation, robotics coincides most closely with
**A)** Programmable **B)** Fixed **C)** Flexible **D)** Process

IV) The robotic configuration used for reaching small opening without interference is
**A)** Cartesian **B)** Articulated **C)** Polar **D)** Jointed arm

V) The configuration of a jointed arm robot is
**A)** TRR **B)** RRL **C)** TRL **D)** LTL

VI) The sensor used to measure velocity is
**A)** Hall effect sensor **B)** Encoder **C)** LVDT **D)** Piezo-electric

VII) PUMA stands for
**A)** Programmable Universal Manipulator Arm
**B)** Programmable United Manipulator for Assembly
**C)** Programmable Universal Manipulator for Assembly
**D)** Parallel United Manipulator for Assembly

VIII) The gripper used to hold pens is
**A)** Suction cups **B)** Constriction type **C)** Magnetic **D)** Adhesive type

IX) The programming method used for arc welding robot is
**A)** Point – Point **B)** Autonomous **C)** Limited sequence **D)** Continuous

X) For a given configuration of a robot, the transmission system providing the maximum reach in the workspace is
**A)** Belt **B)** Rope **C)** Gear **D)** Chain